13.1 – Geographic Information System (GIS) Maps

A Geographical Information System (GIS) is a computer-based system used to manipulate, manage, and analyze multidisciplinary geographic and related attribute data. The GIS system is composed of hardware, software, data, and expertise. A GIS system allows the user to perform several tasks, including data capture, data management, data manipulation, data analysis, and presentation of results in graphic or report forms.

All information in GIS is linked to a spatial reference used to store and access data. GIS data layers can be recombined or manipulated, and analyzed with other layers of information. The GIS allows identification of relationships between features, within a common layer or across layers – and data can be queried or manipulated based on the tabular and/or the spatial characteristics.

One set of maps (**Figures 13.1, 13.3, 13.5, and 13.7**) illustrates the natural renewable resource for the United States by quality of the resource. The transmission grid and the major load centers are overlaid on the resource maps. The major load centers represent the areas in the United States where the vast majority of electricity demand exists (large metropolitan areas). The maps featured here are simplified to make them easier to read. Higher-resolution resource maps are available online (see **Online Resources** later in this chapter.

One of the challenges facing renewable energy is that, in many cases, areas with excellent renewable energy resources have little demand for electricity – while many major load centers are far from areas with good renewable resources.

The other set of maps (**Figures 13.2, 13.4, 13.6, and 13.8**) shows the installed generating capacity from 1996 through 2005 by state. A number in the state shows generating capacity in MW, and a bar chart in the state shows the generating capacity over time.

Biomass

Biomass power utilizes biomass such as wood, agricultural waste, and yard waste through combustion. The biomass fuel is either directly combusted in a boiler, or gasified and then combusted, or turned into a liquid fuel that can be combusted (see the Biomass section of Chapter 2 for more detail on biomass technologies).

Natural Resource

The majority of biomass resources exist east of the Continental Divide (**Figure 13.1**). Biomass resources are derived from the vegetation. Because the western part of the United States has sparse vegetation, the biomass resource in the Western states is generally poor. The Eastern states have much higher-quality resources; and many major load centers in Eastern states are near areas with excellent biomass resources. Alaska has limited biomass resources, while Hawaii has excellent biomass resources on some of the islands.

Installed Capacity

Biomass-generating capacity was nearly level during the past decade, with a slight decline in the past few years (**Figure 13.2**). The largest states, in terms of generating capacity, are Florida (1,051 MW), California (799 MW), and Maine (788 MW).

Geothermal

Geothermal technologies for power generation utilize heat from underground sources to generate electricity. Plants are currently operating in the Western United States (see the Geothermal section of Chapter 2 for more details on geothermal technologies).

Natural Resource

The majority of high-quality geothermal resources exist in the western part of the United States – and, in particular, the Southwest (**Figure 13.3**). Most of the major load areas in the Eastern states are not near any high-quality geothermal resources. The Western states are more promising, as several of the major load centers are in – or close to – high-quality geothermal resources. A good supply of high-quality geothermal resources exists in sparsely populated areas in the West. Alaska and Hawaii both have some areas with excellent geothermal resources.

Installed Capacity

Geothermal generation is currently located in three Western states (**Figure 13.4**). California is by far the largest (2,802 MW), followed by Nevada (272 MW) and Utah (38MW).

Solar

The two most commonly deployed solar power technologies are photovoltaic (PV) and concentrating solar thermal power (CSP) (see the Solar section of Chapter 2 for more information on solar technologies).

Natural Resource

The southern parts of the United States, and especially the southwest, have the greatest potential for solar energy (**Figure 13.5**). This is determined largely by latitude and weather patterns. Solar resources generally decline in quality, moving east and north from the Southwest. The Northeast, as a whole, generally has moderate-quality solar resources. Alaska has moderate solar resources, while Hawaii has good – to very good – solar resources.

Installed Capacity

This map features concentrating solar thermal power (CSP) generating capacity (**Figure 13.6**). Total CSP-generating capacity is virtually unchanged over the past decade. California has the most CSP generating capacity, by far (418 MW), followed by Arizona (10 MW), New York (0.5 MW), Nevada (0.3 MW), and Pennsylvania (0.3 MW).

Wind

Wind power utilizes naturally occurring wind patterns to drive turbines that generate electricity (see the Wind section of Chapter 2 for more information on wind power technologies).

Natural Resource

The wind resources of the United States fall into two major categories: 1) onshore, and 2) offshore. So far, most of the wind resource assessments focused on onshore wind. Most of the best onshore wind resource is in the Midwestern states (**Figure 13.7**). Many of the major load centers in the Eastern states are not located near good wind resources, while some Western load centers are located close to high-quality wind resources.

Installed Capacity

Wind power is the most consistently growing renewable energy technology among those featured in this chapter (**Figure 13.8**). California is the largest state, in terms of capacity (2,150 MW), with Texas close behind (1,995 MW). Iowa, the third-largest state (836 MW), has less than half the capacity of the largest states. Wind-generating capacity is growing rapidly in many states.

Online Resources

For more GIS information, including dynamic maps, GIS data, and analysis tools – as well as downloadable high-resolution maps – please see the NREL GIS Web site at http://www.nrel.gov/gis

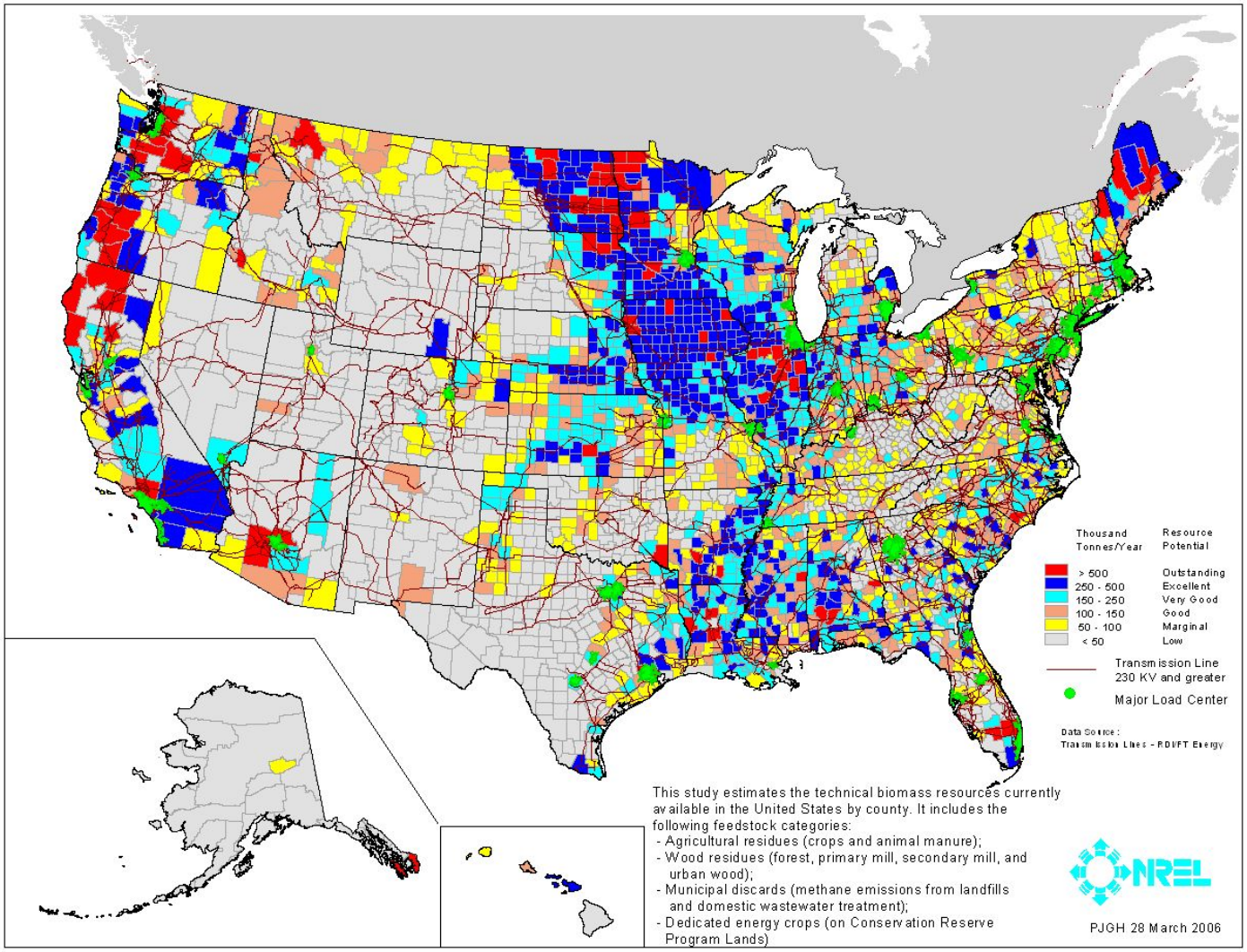

Figure 13.1. Biomass Resources, Transmission, and Load Centers

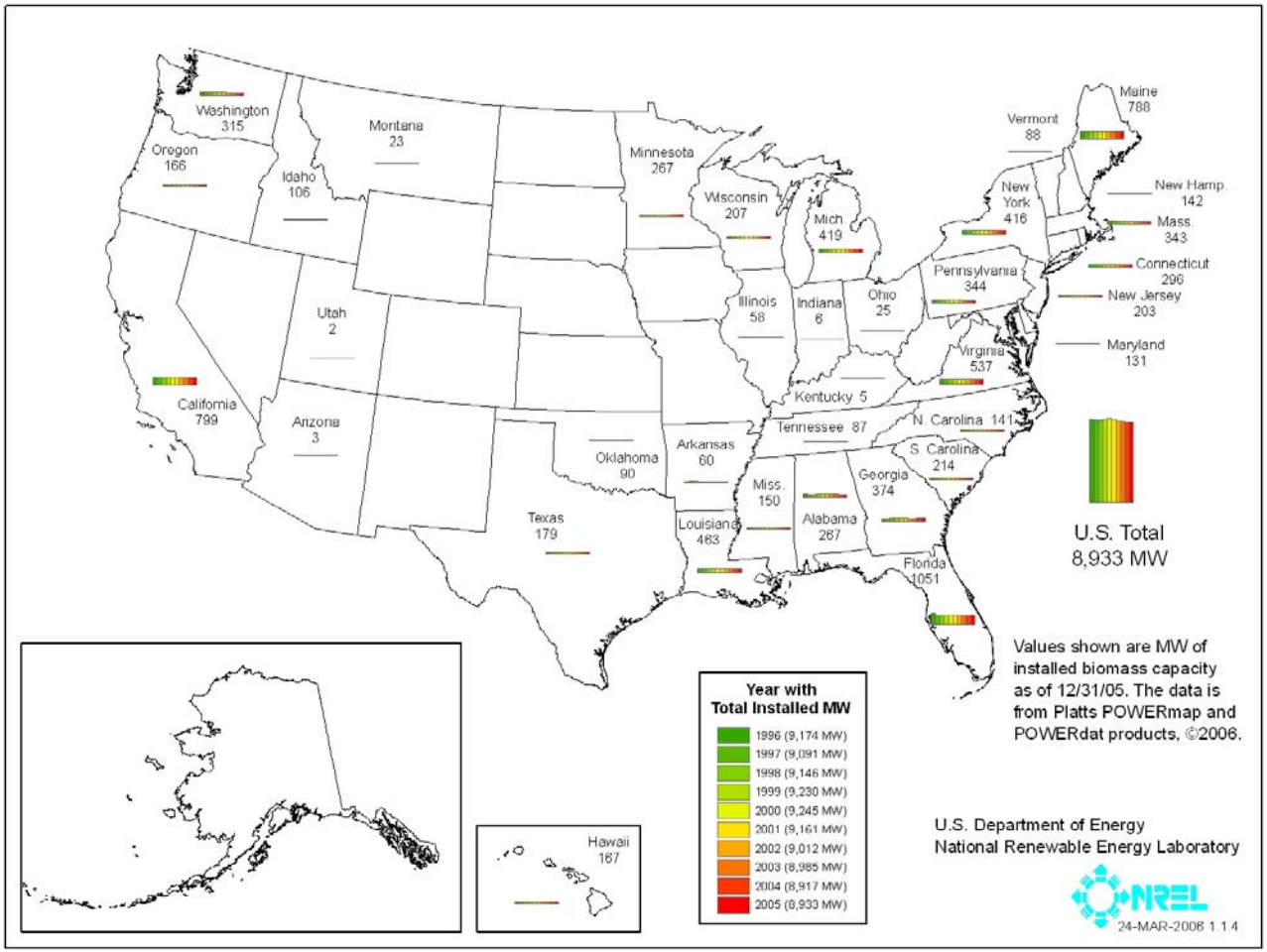

Figure 13.2. Installed Biomass Generating Capacity

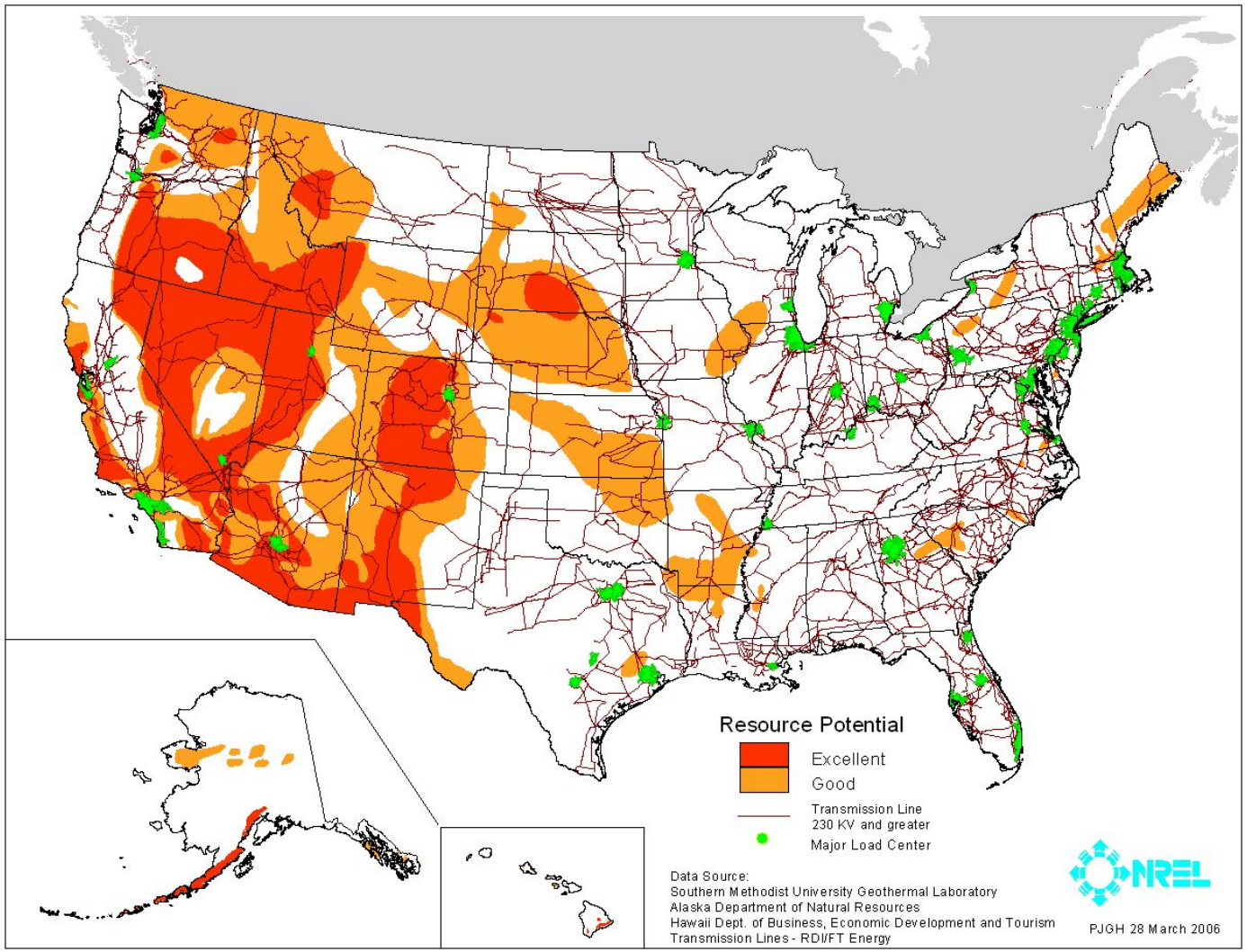

Figure 13.3. Geothermal Resources, Transmission, and Load Centers

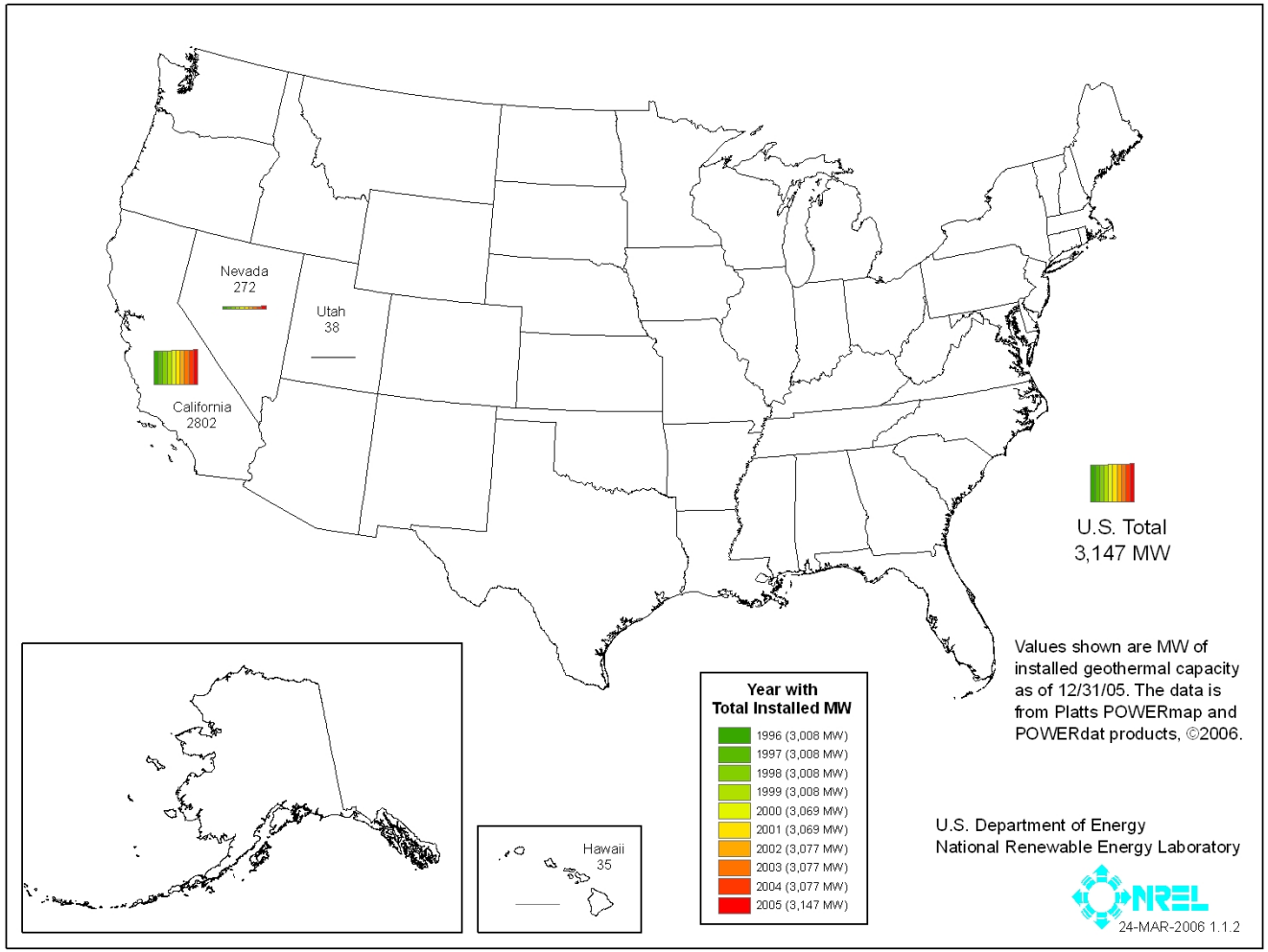

Figure 13.4. Installed Geothermal Generating Capacity

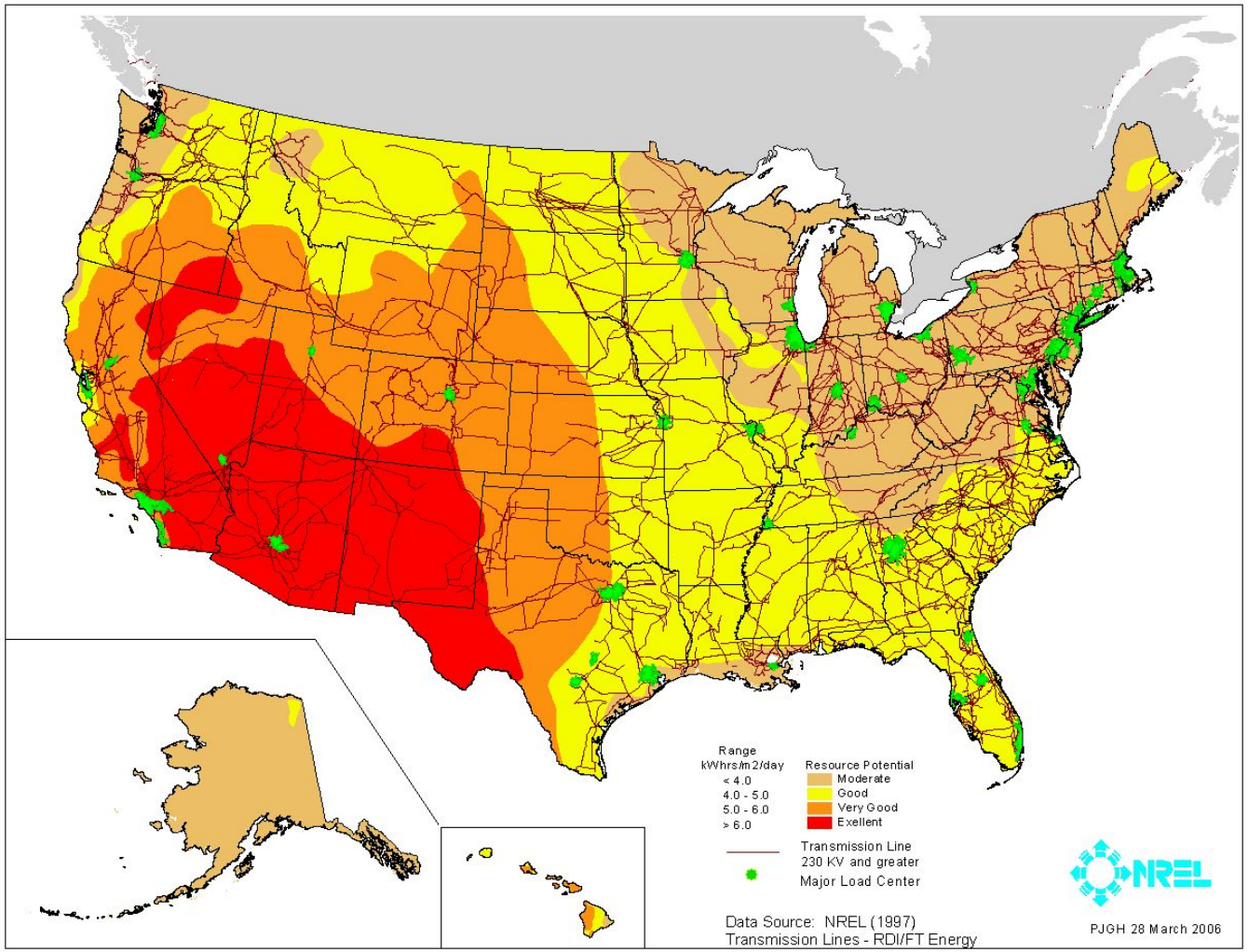

Figure 13.5. Direct Normal Solar Resources, Transmission, and Load Centers

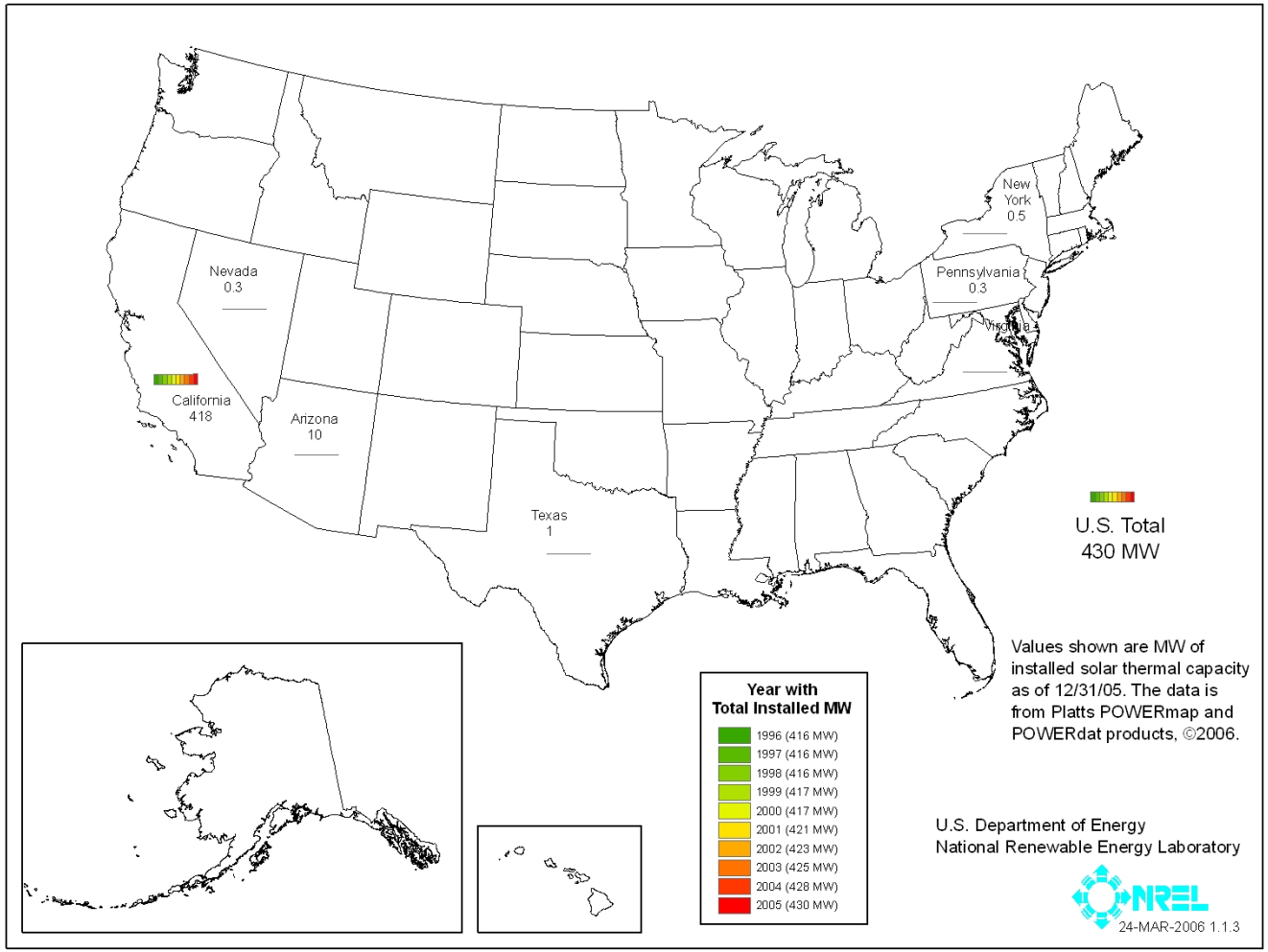

Figure 13.6. Installed CSP Generating Capacity

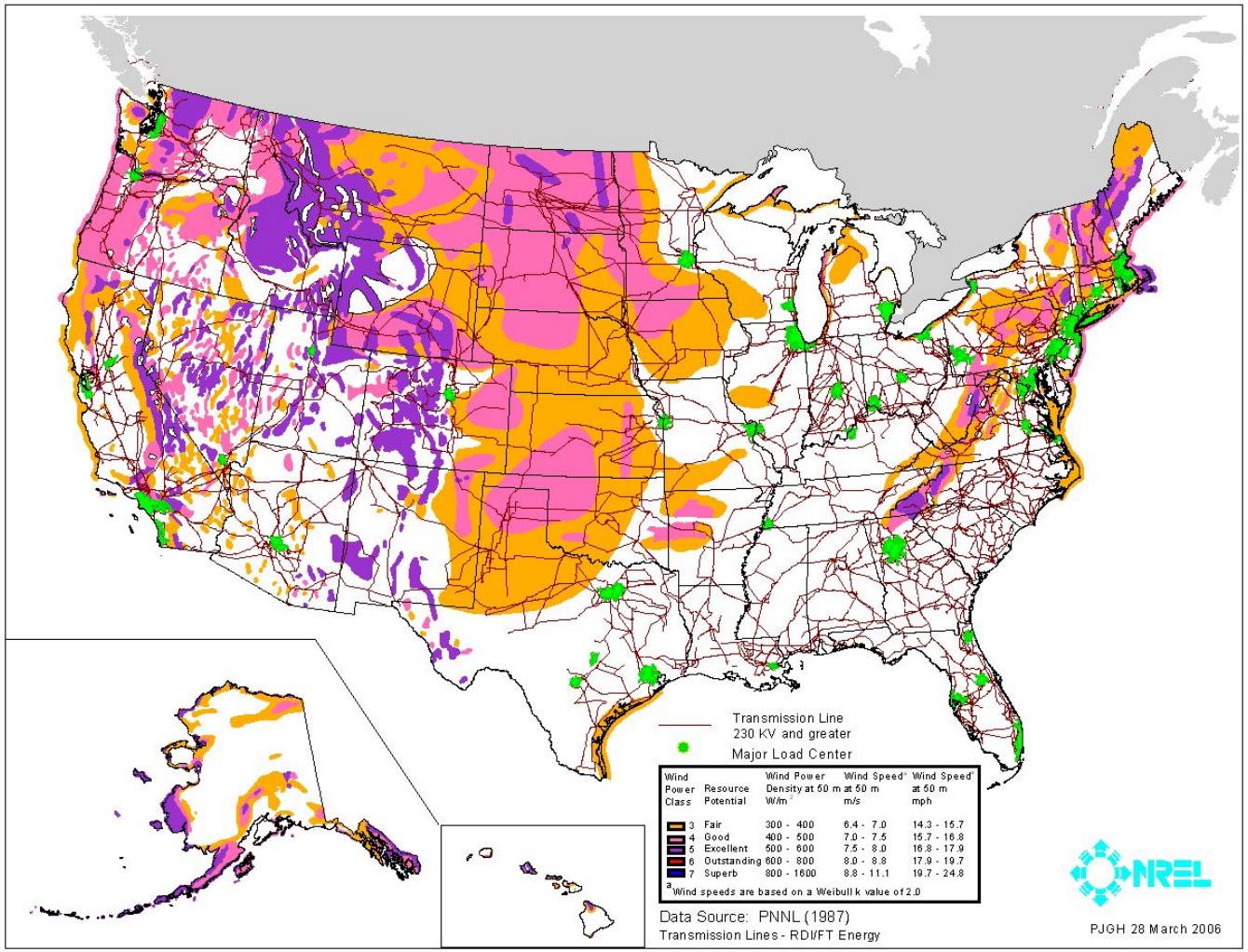

Figure 13.7. Wind Resources, Transmission, and Load Centers

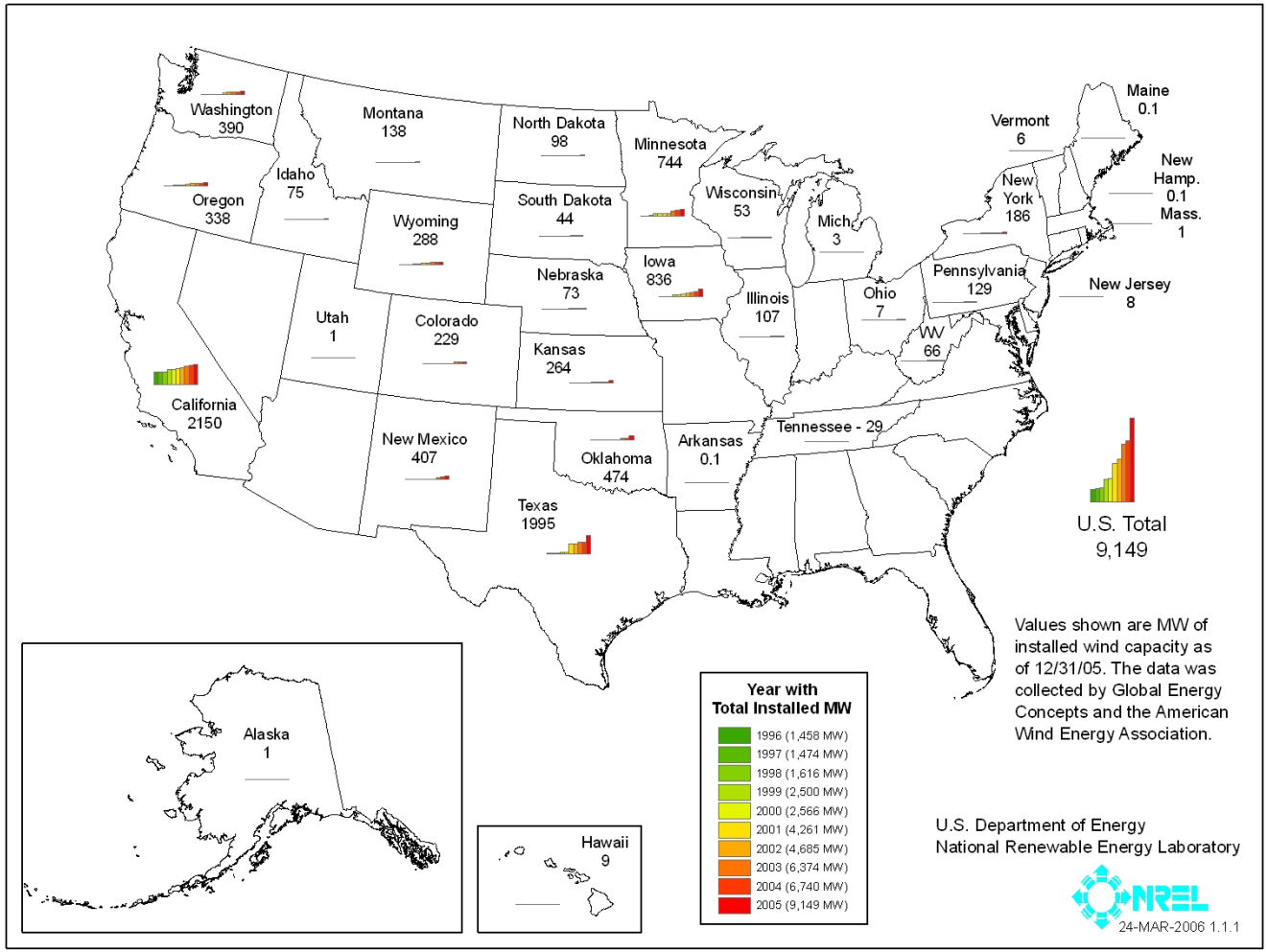

Figure 13.8. Installed Wind Generating Capacity